

MicroBooNE Tank Insulation

Introduction

The liquid Argon tank proposed for the MicroBooNE neutrino experiment is a single shell stainless cylinder without vacuum insulation.

The thermal insulation will be provided at the outside of the tank

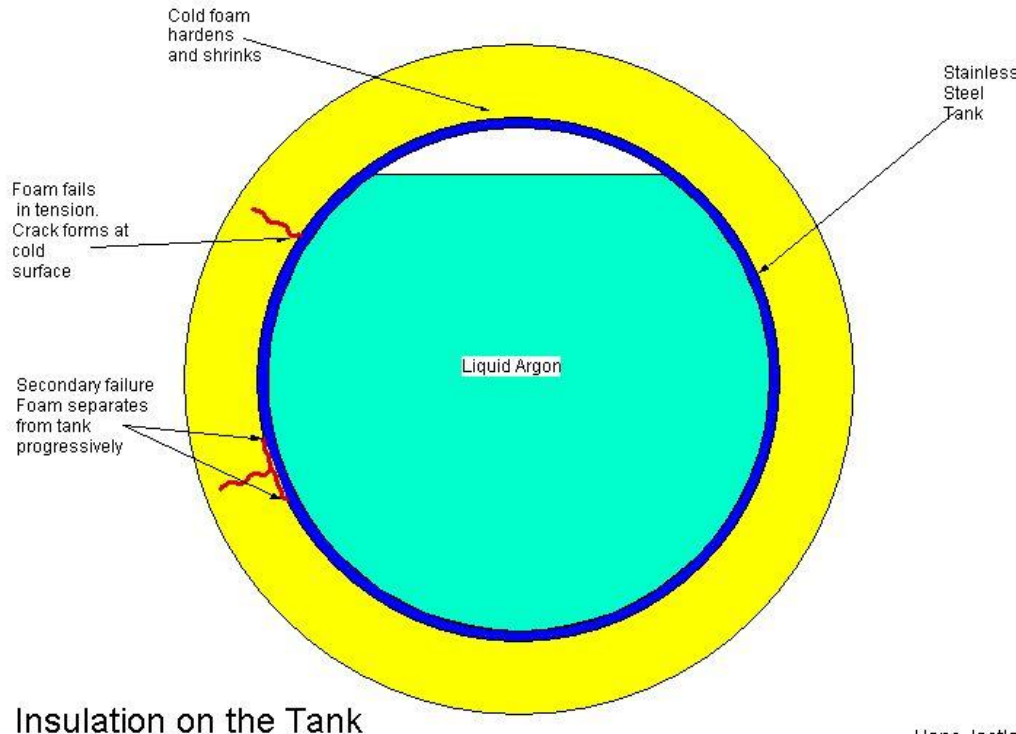
We plan to use blown-in-place
Polyurethane foam insulation.

Properties of Urethane Foam

- good seal against water vapor and air infiltration
- easily adaptable to complex surfaces
(supports, pipe connections, flanges)
- uses minimal space
- widely used commercially
- fast and inexpensive commercial installation

Concerns, mostly relating to thermal contraction stresses:

- will the foam crack on cool-down?
- will the foam separate from the tank surface in a progressive failure mode?
- will radial cracks form on the tank surface and propagate radially outward?



The Cracking Mechanism

On Cooldown, foam shrinks by about 0.95 % while steel shrinks 0.3 %.

The foam is bonded to the steel (or looped around it) and ends up under tension.

We have made two types of measurement:

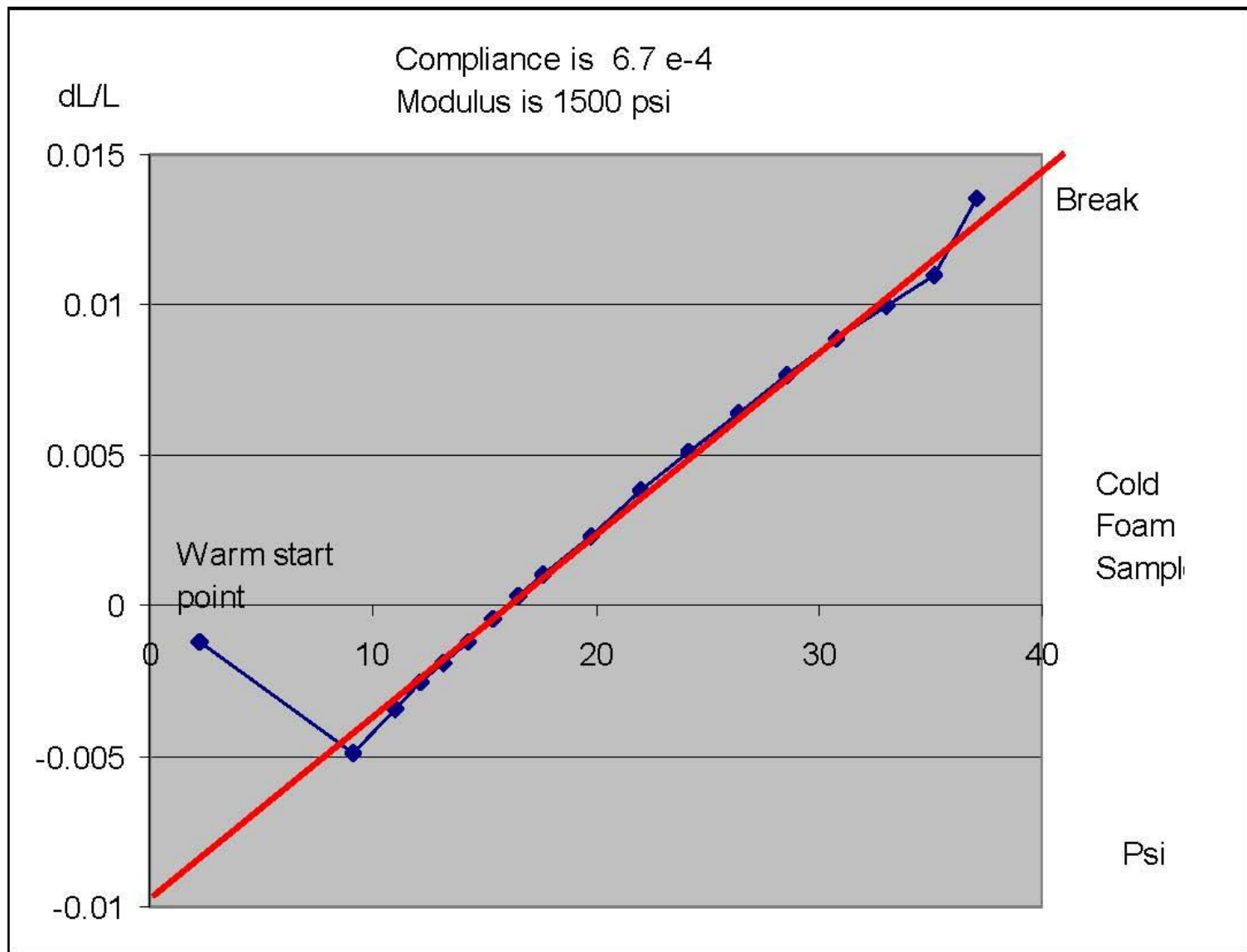
- a. We made many samples of foam on SS, and cold shocked them multiple times -- no cracking or delamination.
- b. To measure a safety factor against cracking, we have measured thermal contraction, cold foam modulus, and tensile strength, on several foam samples. We find a safety factor of about 2 against cracking.

Cold Test Stand



Some of the Samples:





Additional Safeguards against Cracking

We intend to install three layers of fiberglass mesh:

- one in direct contact with the SS vessel
- a second one after the first layer of foam (a 1.5" lift) is installed.
- a third layer will be installed on the surface before the mastic is applied (as per Mfr recommendations)

Other Concerns are:

- we need a water vapor barrier to use on the outer surface to prevent ice formation inside the foam
- fire protection
- protection from physical damage.

These concerns are shared with industrial insulated tanks and have well-known solutions:

The Polyurethane foam has been tested by the Fermilab fire protection engineer and found acceptable. It didn't burn.

The Childers CP-35 is a water soluble mastic with very low permeability and a good fire rating

Commercial Installation

We worked with one commercial installer:

Innovative Insulation Solutions,
Elk Grove Village, Illinois

Foam@gotfoaminsulation.com

